electrodeless discharges was described by G. B. F. Niblett. Interesting streak photographs of the luminosity produced by strong shock waves obtained in argon, helium and deuterium at low pressures by discharging energy (about 1,000 joules) through a single-turn external coil were shown and analysed.

Spark, High-Frequency and Glow Discharges

In order to accommodate the large number of papers submitted, the final session was divided into two sections, running concurrently. One of these, which was devoted to spark, high-frequency and glow discharges, contained two papers by members of the group working under the direction of Prof. F. M. Bruce (Royal College of Science and Technology, Glasgow) on long (~ 5-cm.) uniform field gaps in air at atmospheric pressure. D. T. A. Blair (in a paper with Prof. F. M. Bruce and J. E. Matthews) described simultaneous recordings of light and current pulses in such gaps at voltages just below the breakdown potential, and A. Aked (in a paper with Prof. F. M. Bruce and C. Gordon) described the effect of various parameters, showing that air circulation gives a more reproducible breakdown potential in an enclosed spark gap.

The problems encountered in the application of discharge techniques to industrial conditions were clearly, and often amusingly, illustrated in a paper dealing with electrostatic precipitators by J. S. T. Looms (Central Electricity Research Laboratories, Leatherhead). It was shown how the leakage of air into the flue gas in such precipitators could lead to spark-over.

Other papers in this session were concerned with measurements of breakdown at high frequencies, radio-frequency conductivity in afterglows, breakdown and maintaining potentials in helium – neon mixtures, and the advantages of deuterium over hydrogen as a filling for thyratrons.

Collision Processes and Energy Distributions

The other section of the last session was devoted to collision processes and energy distributions. Dr. J. Thompson (University College, London) concluded, from a study of the energy distribution and concentration of electrons and the temperature and concentration of positive and negative ions in oxygen discharges, that the destruction process for negative ions involves oxygen atoms. Probe measurements in striated positive columns were discussed in a paper by N. D. Twiddy, of University College, London (read by Dr. R. L. F. Boyd), and the existence of two well-separated groups of electrons demonstrated. Theoretical computations of α for argon, helium and neon using an energy distribution function for electrons derived directly from the collision cross-section were discussed in a paper by Dr. A. E. D. Heylen and Dr. T. J. Lewis (Queen Mary College, London). The phenomena attributable to the excitation of hydrogen by electron swarms were shown by Dr. R. W. Lunt (University College, London) to be explicable in terms of the experimental data for mono-energetic beams and the recent predictions of wave-mechanical theory. L. R. Griffin (Swansea) gave results of relative excitation cross-sections in helium computed from the intensities of lines in the spectra from high-frequency glow discharges. A paper by K. Persson (General Electric Research Laboratories, Schenectady), who was unable to be present, was read by Prof. F. Llewellyn Jones. The paper assessed the microwave technique and reported recent measurements on high-density plasmas, showing that the method can be greatly extended by applying solenoidal probing fields on plasmas with rotational symmetry.

During the conference the delegates were welcomed on behalf of the University College of Swansea by the vice-principal at a reception given by the College. Another much-appreciated feature of the proceedings was an afternoon break halfway through the conference, when delegates were enabled to see something of either the industrial life of South Wales at the Abbey Works of the Steel Company of Wales, or the scenic beauty of the Gower Peninsula.

J. Dutton
E. Jones

THE GENUS *DAPHNIA*

DAPHNIA is a genus of freshwater Crustacea the systematic study of which presents many difficulties, although the number of species in the world is not particularly large. The greatest difficulty arises from the fact that many of the species are very variable in conspicuous characters, such as the shape of the head. All the specimens of a species collected at any one time and place are usually very similar to one another, but specimens collected in different bodies of water often show great differences and also may undergo a cyclical series of changes with the seasons of the year. The seasonal rhythm, known as cyclomorphosis, is followed only approximately in the laboratory, and Dr. J. L. Brooks's first study of *Daphnia* was an investigation at Yale of environmental factors concerned, in which his discovery of the importance of the turbulence of the water was new and of great interest. The unsatisfactory state of the systematics of *Daphnia* has hindered his further studies on the evolution of the genus, and his recent memoir* on the systematics of North American *Daphnia* is a result of his very successful attempt to remedy this for that part of the world which concerns him, and since many of the species are also found in Europe and elsewhere, his results are of world-wide interest.

The early workers erected a great many names before it was realized how variable a species of this genus could be, but for the past fifty years or more there has been a great tendency to lump these together, many of the old names being kept for the numerous 'varieties'. Dr. Brooks gives strong support to those who have suggested that the lumping has been excessive, especially with a long series of forms which were called *pulex* if a comb was present on the claw of the tail, or *longispina* if the comb was

* Memoirs of the Connecticut Academy of Arts and Sciences, Vol. 13 (November 1957): The Systematics of North American Daphnia. by John Langdon Brooks. Pp. 180 (61 plates). (New Haven, Conn.: Connecticut Academy of Arts and Sciences, 1957. Obtainable also from Yale University Press.) 8 dollars.

absent. In Europe, under this scheme, the planktonic *Daphnia* of lakes are all varieties of *longispina*, exhibiting great diversity of form and often with marked cyclomorphosis, and *pulex* is confined to small bodies of water; in North America, on the other hand, it is *pulex* forms that inhabit the Great Lakes and exhibit a great diversity of form. Dr. Brooks finds, however, that the true *Daphnia pulex* occurs in North America, but it is found in ponds as it is in Europe, and he assigns other names to most of the species in lakes. He also finds, rather surprisingly, that *Daphnia obtusa* and the true *D. longispina* do not occur in North America, though *D. rosea* does. The latter was thought to be merely a variety of *longispina*, but good evidence for treating it as a separate species is produced, and the applicability of the name for the American specimens is shown by a reproduction of some pencil drawings made of Sars's type specimens by Richard before 1896. It is very fortunate that specimens of Sars's type material of this species now in the British Museum, and which Dr. Brooks had not seen, agree fully with his description. The identification as *D. rosea* of specimens of *longispina* from England in his collections, and also his opinion that *D. hyalina* and *D. galatea* (both also *longispina*) are distinct species, will, if substantiated, lead to changes in the names of British and other European species of *Daphnia*.

In addition to extensive collections from most parts of North America, Dr. Brooks has made good use of the specimens, pencil drawings and other materials relating to the pioneer American workers, Forbes and Herrick, and also to the European authorities, Richard and Sars. This material has enabled him to find the correct names for the fifteen species which concern him from among names already published, in spite of the inadequacy by modern standards of the older original descriptions. To have found an appropriate name in each case, and to have been able to give his reasons clearly and convincingly, is a great tribute to his patience and skill. A lesser man would have invented a series of new names.

The bulk of the work is occupied by careful and very full descriptions of the fifteen species, with good line drawings and information on the geographical distribution and ecology. There is also a key to the species with the diagnostic characters figured at the side of the page, and an ingenious method of linking the drawings with the key. A separate part of the work is devoted to a discussion of ten separate regions of North America which the author has been able to distinguish on the basis of the distributions of the species, complex though these are.

Of particular interest in Britain is Dr. Brooks's discovery that *D. ambigua* is a widely spread North American species, for until now this species had been known only in England. It was first found in a pond in the Royal Botanic Gardens at Kew, and described by Scourfield in 1946, who suggested at the time that it had been introduced from abroad with aquatic plants.

This memoir whets the appetite for further publications in which an elaboration is promised of theoretical considerations, including the reasons for the author's belief in the adaptive significance of the extensive cyclomorphic variation in the genus *Daphnia*, which he suggests is the most interesting of the fruits of his study of their systematics.

J. P. Harding

A CLIMATOLOGICAL WIND TUNNEL

By Dr. P. E. WEATHERLEY and H. D. BARRS
University of Nottingham

In our studies of the water economy of plants it has proved necessary to subject as many as thirty large potted plants to known atmospheric conditions. For this purpose a wind-tunnel has been constructed at Nottingham which provides an air-stream of controlled speed, temperature and humidity. The control of these major atmospheric factors has been so successful that the details of the equipment may well be of interest in wider fields of research than those for which it was designed.

Our aim has been to control temperature, humidity and wind speed independently, thus making it possible to realize any one of a wide range of atmospheric conditions. Furthermore, it was not only necessary to hold any reasonable combination of temperature and humidity constant, but also to be able to change from one set of conditions to another fairly rapidly and even, if possible, to change conditions continuously and smoothly in a known way; in other words, to set a programme of climatic change. The equipment to be described fulfils these aims in large measure. The wind-speed can be varied between 2 and 16 ft./sec., the temperature between 10° and 40° C., and the relative humidity between 40 and 100 per cent at temperatures around 25° C., while at 35° C. a relative humidity as low as 25 per cent can be achieved.

In the first instance, no control of light has been attempted, natural light being used by constructing the working section of the tunnel of glass and erecting the tunnel in a glasshouse. Fig. 1 represents sections of the equipment seen from the side and end. The tunnel is of a closed-circuit type, and has a working compartment 12 ft. long, 3 ft. wide and 2½ ft. high, below which is a trough 14 in. deep for the pots. Thus, the pots are kept out of the main air-stream. This compartment consists of a wooden frame bearing glass panels those forming the sides being fitted in felt-lined grooves to slide vertically and give access to the tunnel. The end sections and return duct underneath the working compartment are lined with tempered hardboard and have cavity walls for heat insulation.

The aerofoil fan *F* (Fig. 1) is belt-driven by an externally placed 4 h.p. d.c. motor connected to a Ward Leonard set giving speed regulation by voltage control. The air stream is deflected through two right angles by the guide veins *G*, through section *C* containing the sensitive elements of the control system, to the working compartment via the honeycomb *H*. This arrangement gives an even distribution of air-flow in the working compartment, no more than 5 per cent variation in wind-speed occurring across the tunnel. No guide veins are used at the